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Utilization of the Topsis Method in Determining Operationally Worthy Vehicles at the Tirtanadi PDAM Office, North Sumatra Province

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ABSTRACT

PDAM Tirtanadi Sumut provides a supporting facility, one of which is operations that are used in carrying out daily employee activities. The problem has occurred that many operational vehicle are no longer suitable for use because the age of the vehicle is long. the cost of spare parts that are increasingly being replaced makes the company have to spend quite a lot of money to buy spare parts and repair the operational vehicle. The purpose of this study is to assist PDAM Tirtandi, North Sumatra Province in determining suitable cars to use using the Topsis method (Technique For Order Preference By Similarity To Ideal Solution) and it is hoped that this method will be able to determine suitable operational vehicles at the North Sumatra Province PDAM office.

Keyword: Operational Vehicle; Sparepart; Topsis Method; Supporting Facility; Tirtanadi SUMUT

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1. INTRODUCTION

Information technology is a technology that is used to process data, including processing, receiving, compiling, storing, manipulating data in various ways to form quality information, namely information that is relevant, accurate and timely [1]. PDAM Tirtanadi, North Sumatra Province itself is a leading drinking water and wastewater management company in Indonesia, especially in the North Sumatra Province area. In supporting the performance of the company, PDAM Tirtanadi North Sumatra provides a supporting facility, one of which is an operational vehicle that is used to carry out daily employee activities.

These operational vehicles include employees' cars with certain positions in the company and water tankers. The problem is that many operational vehicles are no longer suitable for use because the vehicles are old. Plus the cost of spare parts which are being replaced more and more, the company has to spend quite a lot of money to buy spare parts and repair these operational vehicles, and reduce activities and use of paper when inputting operational vehicle data that is fit for use. for this reason, the company must determine operational vehicles that are still suitable for use and cars that are not suitable for use not to be used again. To overcome the problems above, the researchers tried to make a decision support system application in determining a suitable car for PDAM Tirtanadi North Sumatra. Decision support systems are defined as information systems that provide information, modeling, and data manipulation. This system aims to assist decision making in semi-structured situations and unstructured situations, where no one knows for sure how decisions should be made [2].

One of the decision support system methods used in conducting this research is the Topsis method (Technique for Order Preference by Similarity to Ideal Solution) which is a multi-criteria decision-making method that was first introduced by Yoon and Hwang [3]. The Topsis method uses the principle that the chosen alternative must have the shortest distance from the positive ideal solution and the farthest from the negative ideal solution from a geometric point of view by using Euclidean distance to determine the relative proximity of an alternative to the optimal solution [4]. Based on the

above problems that have been explained, the authors try to conduct research with the title "Utilization of the Topsis Method in Determining Operational Vehicles Worth Using at the Tirtanadi PDAM Office, North Sumatra Province".

2. RESEARCH METHOD

The first step in using the Multi Attribute Utility Theory (MAUT) method is to assign a weight value to each operational vehicle criterion that will be studied [5]. The criteria can be made in table 1 below:

Table 1. Criteria for Decent Cars

Code	Criterua Name Weight	Value Category	Criteria
C001	Sparepart	0,20	Cost
C002	Millage	0,35	Benefit
C003	Vehicle Year	0,20	Benefit
C004	Damage Rate	0,25	Cost

Determine Sub Criteria From the criteria that have been given a value per criterion, then determine the sub-criteria of the criteria that have been explained in table 2.

Table 2. Spare parts sub criteria

Name Of Assesment	Weight Criteria
Easy to find	1
Hard to find	0,7
Very hart ti find	0,3

Giving Weight Per Criteria From the criteria that have been given a value per criterion, then determine the sub-criteria of the criteria that have been explained in table 3.

Table 3. Spare parts sub criteria

Name Of Assesment	Weight Criteria
0 to 25,000 Km	1
25,000 to 40,000 Km	0,8
40,000 to 100,000 Km	0,3
100,000 Km	0,4

Table 4. Mileage Sub Criteria

Name Of Assesment	Weight Criteria
0 to 25,000 Km	1
25,000 to 40,000 Km	0,8
40,000 to 100,000 Km	0,3
100,000 Km	0,4

Table 5. Sub Criteria for Damage Level

Name of Assessment	Weight Criteria
Easy	1
Very Easy	0.8
Difficult	0.5
Very Difficult	0.3

After determining the criteria in the assessment, then determine alternative data or sample data to be studied. The data is as follows:

Table 6. Alternative Operational Vehicle Data

Alternative Code	Name of Vehicle	Type
A01	Avanza	Personal
A02	Avanza	Personal
A03	Avanza	Personal
A04	Avanza	Personal
A05	Fuso Tank Car	Tank Car
A06	Fuso Tank Car	Tank Car
A07	Innova	Personal
A08	Avanza	Personal
A09	Innova	Personal
A10	Avanza	Personal

Provision of Criteria for Alternatives After determining the alternative data to be examined, then the criteria for each alternative are given, while the data is as follows:

Table 7. Provision of Criteria for Alternatives

	C1	C2	C3	C4
A01	1	0.4	1	1
A02	1	0.4	1	1
A03	0.7	0.5	1	1
A04	0.7	0.5	0.8	0.7
A05	1	0.5	1	1
A06	0.7	1	1	1
A07	0.7	0.5	0.8	0.7
A08	1	0.5	1	1
A09	0.7	1	0.5	1
A10	0.7	1	0.8	0.7

Determining Normalized Decisions After giving the value of each alternative, then determining a normalized decision, the formula and calculations are as follows [6]:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_i^m = X_{ij}^2}}$$

Table 8. Determining Normalized Decisions

Alternatif	$\sqrt{\sum_i^m = X_{ij}^2}$	$\sqrt{\sum_i^m = X_{ij}^2}$	$\sqrt{\sum_i^m = X_{ij}^2}$	$\sqrt{\sum_i^m = X_{ij}^2}$
	67,24	39,69	79,21	82,81
	Kriteria			
	C1	C2	C3	C4
A01	0,015	0,10	0,013	0,012
A02	0,015	0,10	0,013	0,012
A03	0,010	0,13	0,013	0,012
A04	0,010	0,13	0,011	0,008

A05	0,015	0,13	0,013	0,012
A06	0,010	0,025	0,013	0,012
A07	0,010	0,13	0,011	0,008
A08	0,015	0,13	0,013	0,012
A09	0,010	0,025	0,006	0,012
A10	0,010	0,025	0,011	0,008

Create a weighted Normalized Matrix y Then look for the weighted normalized value y which has been obtained through calculations from table 9, while the results are as follows: [7]

$$y_{ij} = w_i r_{ij} (2.2) \quad (2)$$

$$W=(\ 0{,}20, 0{,}35, 0{,}20, 0{,}25) \quad (3)$$

Table 9. Weighted Normalized Matrix y

Alternative	Criteria			
	C1	C2	C3	C4
A01	0,003	0,035	0,0026	0,0024
A02	0,003	0,035	0,0026	0,0024
A03	0,002	0,0455	0,0026	0,0024
A04	0,002	0,0455	0,0022	0,0016
A05	0,003	0,0455	0,0026	0,0024
A06	0,002	0,00875	0,0026	0,0024
A07	0,002	0,0455	0,0022	0,0016
A08	0,003	0,0455	0,0026	0,0024
A09	0,002	0,00875	0,0012	0,0024
A10	0,002	0,00875	0,0022	0,0016

Define Preference Values Then determine the preference value of the alternatives that have been obtained, while the calculation is as follows:

$$V_i = \frac{D_j^-}{D_i^- + D_i^+} \quad (2.5)$$

$$V_1 = \frac{0{,}058}{0{,}058 + 0{,}010} = 0{,}852$$

$$V_2 = \frac{0{,}058}{0{,}058 + 0{,}010} = 0{,}852$$

$$V_3 = \frac{0{,}073}{0{,}073 + 0{,}0008} = 0{,}989$$

$$V_4 = \frac{0{,}095}{0{,}095 + 0{,}0004} = 0{,}995$$

$$V_5 = \frac{0{,}045}{0{,}045 + 0{,}0010} = 0{,}978$$

$$V_6 = \frac{0{,}047}{0{,}047 + 0{,}053} = 0{,}459$$

$$V_7 = \frac{0{,}049}{0{,}049 + 0{,}0004} = 0{,}991$$

$$V_8 = \frac{0{,}046}{0{,}046 + 0{,}016} = 0{,}741$$

$$V_9 = \frac{0{,}010}{0{,}010 + 0{,}036} = 0{,}217$$

$$V_{10} = \frac{0{,}046}{0{,}046 + 0{,}052} = 0{,}469$$

After successfully calculating preferences, the rankings obtained regarding cars that are suitable for use are as follows:

Table 10. Ranking Results

No.	Alternative Code	Alternative	Mark
1	A04	Innova	0,995
2	A07	Innova	0,991
3	A03	Avanza	0,989
4	A05	Fuso Tank Car	0,978
5	A01	Avanza	0,852
6	A02	Avanza	0,852
7	A08	Avanza	0,741
8	A010	Avanza	0,469
9	A06	Fuso Tank Car	0,459
10	A09	Avanza	0,217

3. RESULTS AND DISCUSSION

After this research was carried out, the next step was to show the results of the research and conduct system testing. The system that has been designed consists of several pages that have their respective functions. The page that will be displayed is as follows

1. Login Page

This page displays the initial display which is for users to enter the system. The appearance is as follows:

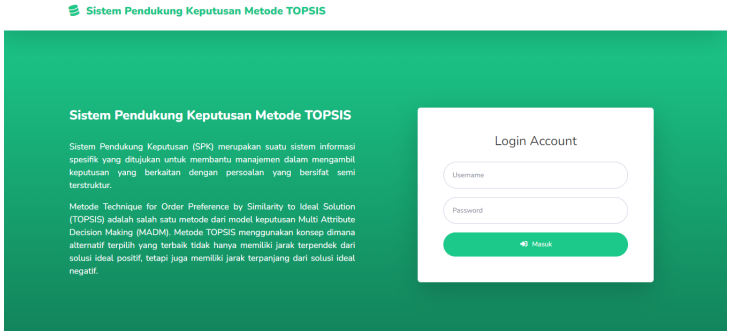

Figure 1. Login Page

2. Dashboard page

On the page there are several menus later users can access them. The appearance is as follows:

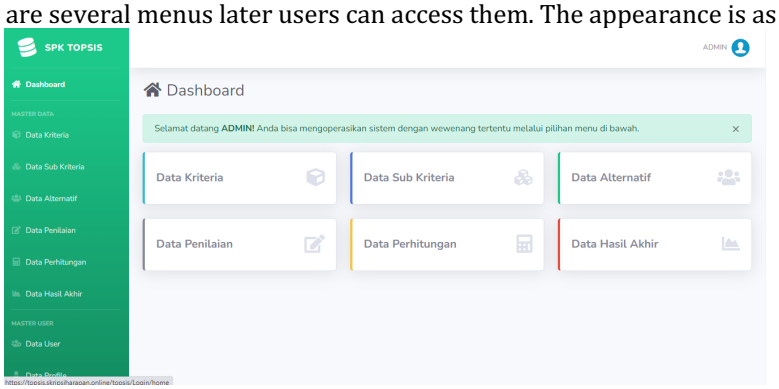

Figure 2. Dashboard Page

3. Add Criteria Data page

This page is used by users to add criteria data to the system. The appearance is as follows:

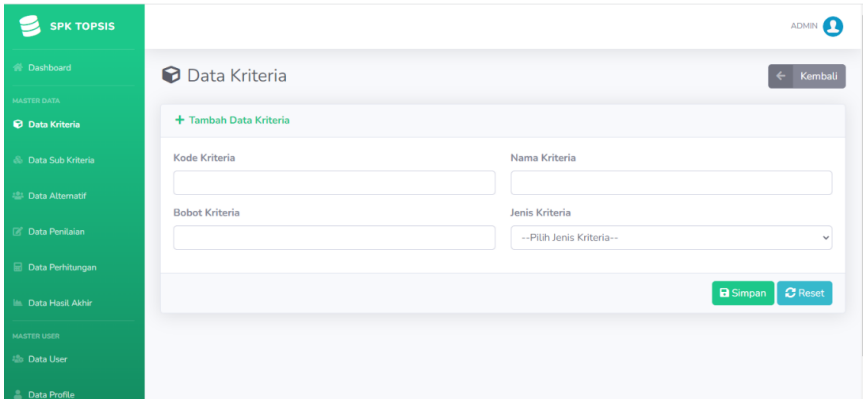

Figure 3. Add Criteria Data Page

4. Criteria Page

This page serves to store the criteria data that has been created by the user. The appearance is as follows:

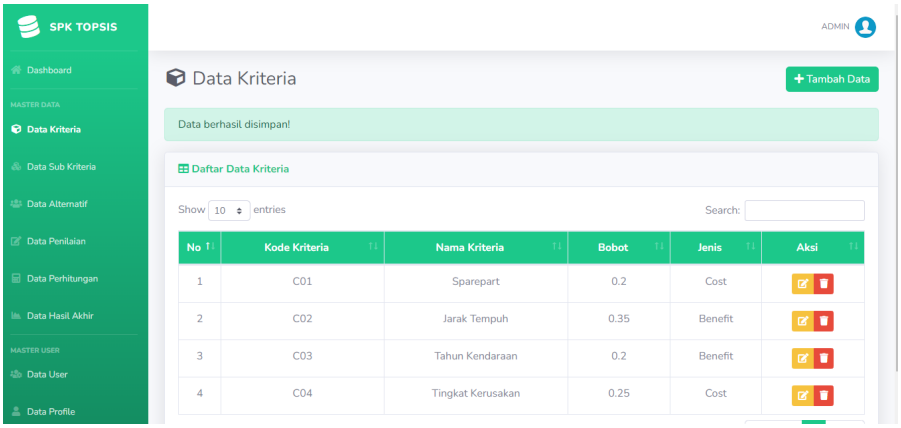

Figure 4. Criteria Page

5. Add Alternative Page

This page is used by the user to enter alternatives into the system. The appearance is as follows

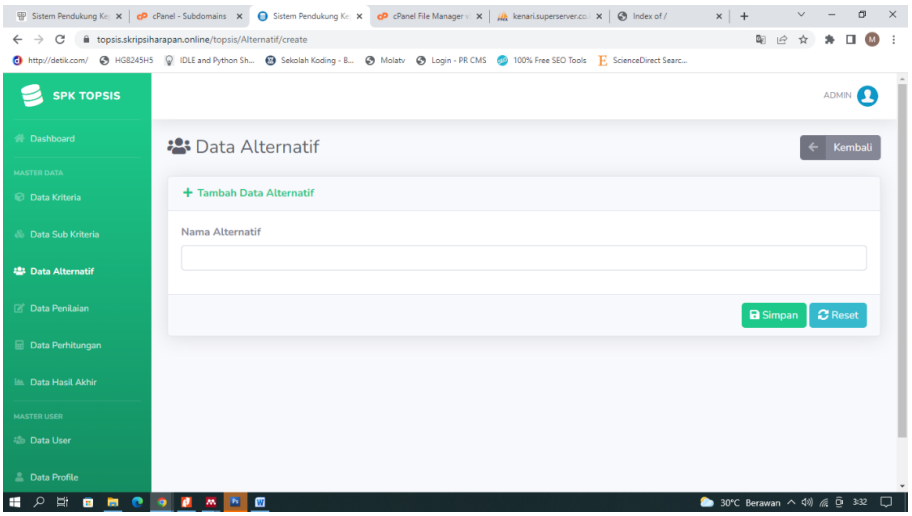

Figure 5. Add Alternative Page

6. Alternative Pages
This page is used by the user to store alternative data that has been entered into the system. The appearance is as follows:

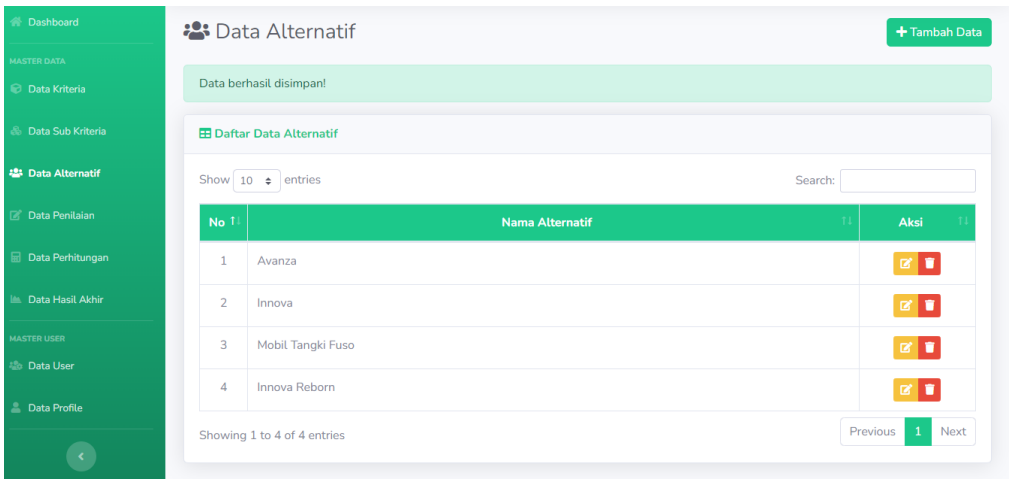

Figure 6. Alternative Pages

7. Sub Criteria page
This page is used by users to enter sub-criteria against existing criteria data. The appearance is as follows:

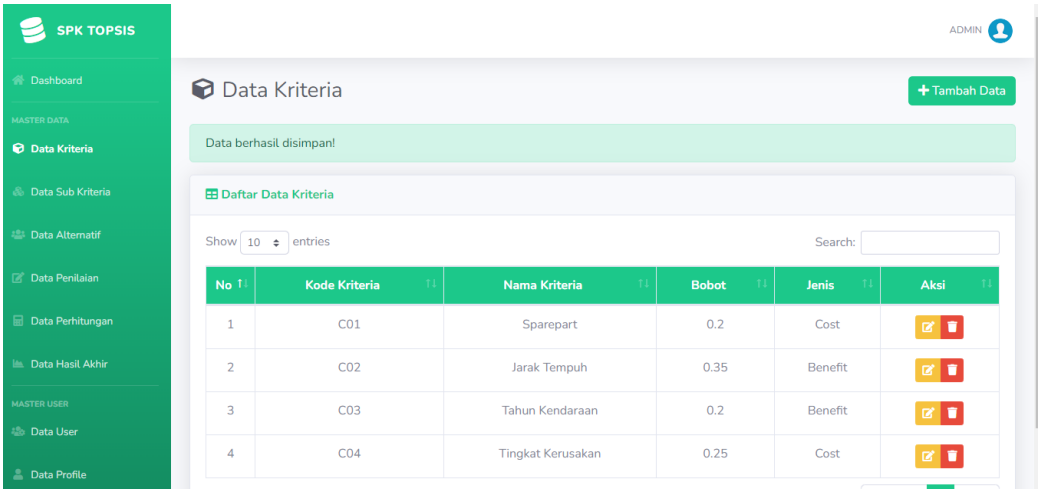

Figure 7. Sub Criteria page

8. Assessment Data Page
This page is used by users to view assessment data that is automatically carried out by the system. The appearance is as follows:

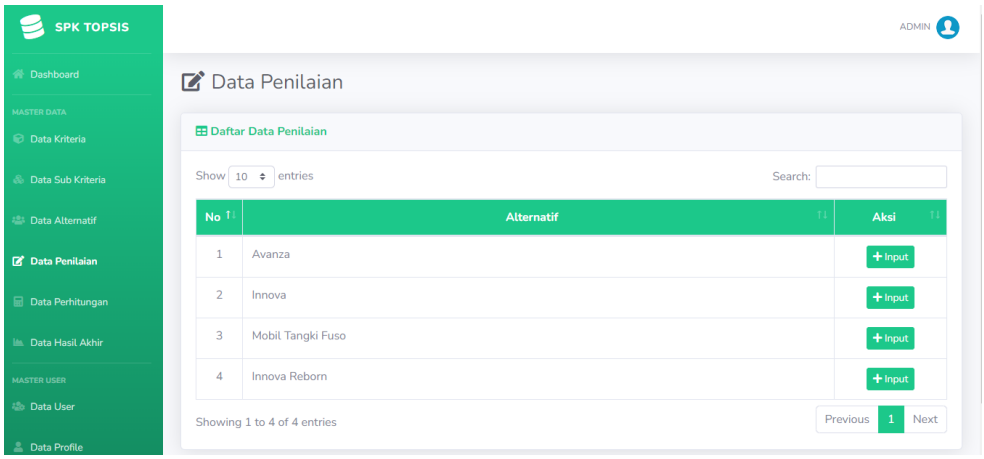

Figure 8. Assessment Data Page

9. Calculation Data Page

This page functions for users to see the final results of calculations that have been automatically calculated through the system. The appearance is as follows:

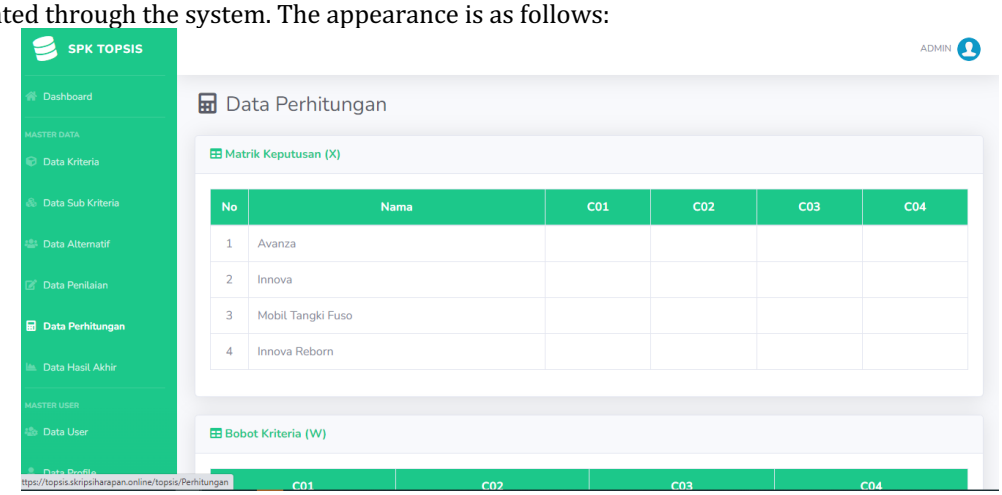

Figure 9 . Calculation Data Page

4. CONCLUSION

Based on the results of the research and discussion that the author has carried out, it can be concluded that the Decision Support system that has been made can produce accurate calculations and will make accurate decisions in determining operational vehicles that are feasible to use for North Sumatra PDAM companies. The decision support system application by applying the topsis method was successfully built using the codeigneiter framework with a web-based mysql database in determining operational vehicles that are feasible to use for North Smatera PDAM companies. By using the Topsis method, the determination of operational vehicles that are suitable for use by North Sumatra PDAM companies can be carried out effectively based on predetermined criteria. Simplify and speed up the input time for operational vehicle data that is suitable for use at the PDAM North Sumatra office.

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